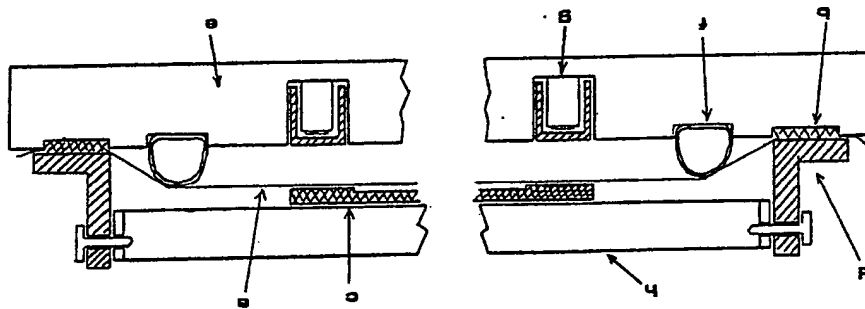




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: <b>DIAPHRAGM STRETCHING APPARATUS</b>		



## (57) Abstract

Diaphragm stretching apparatus to be placed in electrostatic loudspeakers, consisting of a foundation plate (e) and a hinged metal frame (d) on which a stator panel (c) is attached. In flatable rubber tubes (f) connected to each other in opposite pairs, are attached to the foundation plate and are activated by inflating. This to allow a quick and adjustable stretch to be obtained in the superpositioned plastic base membrane which is fixed by hard rubber cleats (b) on the metal frame and on the foundation plate outside the rubber tubes. A glue string is applicated on the stator panel and the base is after that elevated and fixed onto the panel in a stretched state. By giving the tubes different pressure, the membrane can be stretched differently in different directions.

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## I.

Diaphragm Stretching Apparatus.

The invention concerns an apparatus to be used in connection with the stretching of a plastis base aimed to be placed in electrostatic speakers.

Elektrostatic speakers or condenser panels, under which  
5 name they are known too, are considered being the prime source of reproducing different acoustic signals. However, so far this type of speaker represented only sporadically within the Hi-fi-line of business. One explanation of that phenomenon is the fairly high price level, another the du-  
10 rability as a consequence of the inexpedient load of the system.

The following will not deal with the advantages of electrostatic speakers, we shall only refer to relevant technical literature on this specific subject.

15 However, it has to be emphasized that the electrostatic principle makes use of a diaphragm that is approx. 100 times lighter than the one that is used in conventional electrodynamic speakers. The very thin diaphragm thus creates superior transient-characteristics which ensure a very  
20 realistic sound reproduction.

As preciously mentioned the inferior durability has been one of the explanations of the electrostatic speakers not having succeeded. The reason for that has been the material used for the diaphragm. Formerly this material was most often parch-  
25 ment paper. By maximum signal intensity from the amplifier the diaphragm could easily burn through as a consequence of electric sparks. The sparking itself occurs either by impurities between diaphragm and stator or by the very large vibrations, where the diaphragm is too close to the stators



## 2.

and may touch these. Today polyester bases are used for diaphragm in electrostatic speakers, which reduce the above problems - it is indeed very important to insulate the stator as well as the diaphragm as effectively as possible.

5 The invention concerns the stretching of the diaphragm. It is necessary to dispose of an apparatus which makes it possible to stretch out and adjust the very thin diaphragm (6 micron), that in addition too has a relatively large surface approx. 25 x 85 cm. This stretching has been obtained by means of a  
10 pneumatic principle. The known method for stretching diaphragms in electrostatic speakers and condenser microphones, which in principle are related to electrostatic speakers, is the use of clips which are placed near the edge of the plastic base, stretched, and then fixed to the frame. It is also possible  
15 to bend the base, viz it is forced over the edge and glued, furthermore it is possible to use several screw systems to tighten the diaphragm.

The apparatus consists of a foundation plate (Fig.I) with a measure of 120 x 50 cm. On this plate 4 cleats of hard-rubber  
20 are mounted. The cleats have been placed in a rectangle and together with the below-mentioned metal frame (Fig.II) they have the purpose of securing the plastic base. Within the 4 rubber cleats 4 grooves have been milled in the foundation plate parallel to the cleats. In the grooves 4 inflatable  
25 rubber tubes have been placed. The rubber tubes can be insufflated two and two - viz in opposite pairs, independent of each other. The insufflation is carried out by means of insufflation balloons, each equipped with a manometer. This procedure permits different stretch of the base in 2 dimen-  
30 sions of the plane. Having different stretch in the base is a physical condition of the entire surface of the diaphragm remaining in the same distance from the stator, thereby does not press itself to this, when the diaphragm is intended to



3.

curve slightly. Such a curve is often required due to the sound spreading, which is improved this way. Within the rubber tubes, parallel with these, 4 metal beams are placed in the grooves in the plate. These metal beams are provided  
5 with thermostatically controlled heating elements, and they can be lifted hydraulically. The purpose of the beams is to fix the diaphragm to the stator with thermo-setting glue.

Furthermore the apparatus consists of a metal frame (Fig.II), which is hinged to the foundation plate. Rubber cleats, of  
10 the same kind as previously mentioned, are mounted on the under side of the frame. In addition to this, metal bars have been placed in the frame - these bars serve the purpose of supporting the stator and of fixing it with some spring clips. The metal bars are adjustable in order to adjust the position  
15 above the foundation plate.

In comparison with the known technique this apparatus is characterized by the use of pneumatic. First of all a very uniform and controllable stretch of the base is obtained by this method, as the rubber tubes exert the same pressure on  
20 each point of the base, secondly the method is very fast and safe and it complies with the wish for a curved stator panel. A certain reading of the manometers corresponds to an air pressure in the rubber tubes, which results in a given stretch of the base, when these are pressed against it.



4.

On the drawings ( Fig. I-IV ) following items are shown:

- Fig. I Foundation plate from above with rubber cleats, rubber tubes and metal beam ( is lifted hydraulically ).
- 5 Fig. II Metal frame with rubber cleats and adjustable metal bar serving the purpose of being fixture for the stator. The frame is equipped with hinges and is mounted on the foundation plate, so that the frame can be opened and closed.
- 10 Fig. III Sectional view of the apparatus ( Fig. I and II ). The base is shown in stretched position and the rubber tubes are inflated with air.
- Fig. IV Sectional view of the apparatus. 4 working operations are shown here.
- I. Base and stator have been placed.
  2. The rubber tubes are inflated and the base is stretched.
  3. The metal beam is lifted and glues the base.
  4. Rubber tubes are decompressed.

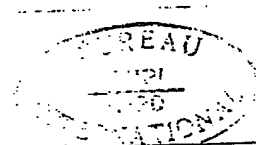
20 The procedure of stretching out the base is as follows:

- I. The base a Fig. IV is placed so that it only reaches slightly beyond the outer edge b Fig. IV of the rubber cleats.
- 25 2. The stator c Fig. III is placed in the metal bar h Fig. III. In advance thermo-setting glue has been applied to the lower edge of the stator in a width of approx. 15 mm.



5.

3. The frame d Fig. II is closed, so that the base is fixed between the rubber cleats b Fig. III.
4. The rubber tubes f Fig. III are inflated with air till they reach a suitable pressure, the value of which appears on the manometer. The base is stretched by this procedure.
5. The heated metal beam g Fig. III is lifted and presses the base a towards the stator c, on which glue has been applied, and the accelerated hardening starts.
6. Finally tubes and beam are decompressed and the stator with the stretched base can be taken out.



6.

CLAIMS

1. Apparatus for quick and uniform stretching of thin plastic base ( 6-12 microns ), which is used as a diaphragm in electrostatic speakers, and the base is glued to the stator panel. The apparatus is used in the production of electrostatic speakers.
2. The known technique for stretching of base is carried out by means of clips in the edge of the base, tightening by screw systems or deflection of the base, ( The base is forced over an edge ).
3. The apparatus is characterized by 4 inflatable rubber tubes. The rubber tubes of Fig. III are connected to each other two and two in opposite pairs and they are activated by 2 insufflating balloons with manometers. By using inflatable rubber tubes a quick and adjustable compressive stress is obtained, which is completely even dispersed on a superpositioned and fixed plastic base of Fig. III. The apparatus secures the center position of the stretched diaphragm in the stator panel, if this is preferred to be slightly curved. The rubber tubes can be insufflated independently two and two in opposite pairs, and the two dimensions of the plane can thus be stretched differently.





FIG 1

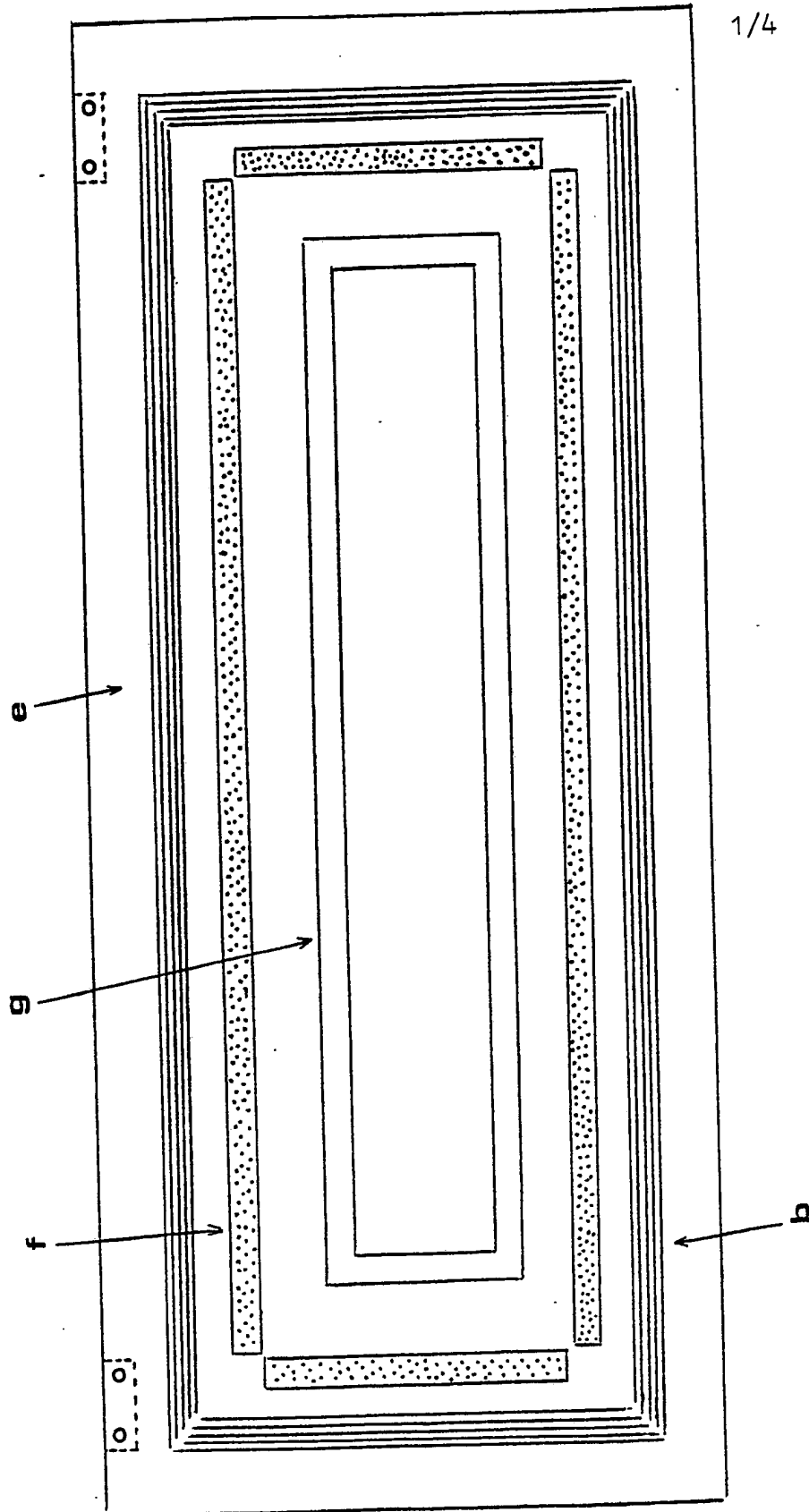


FIG 2

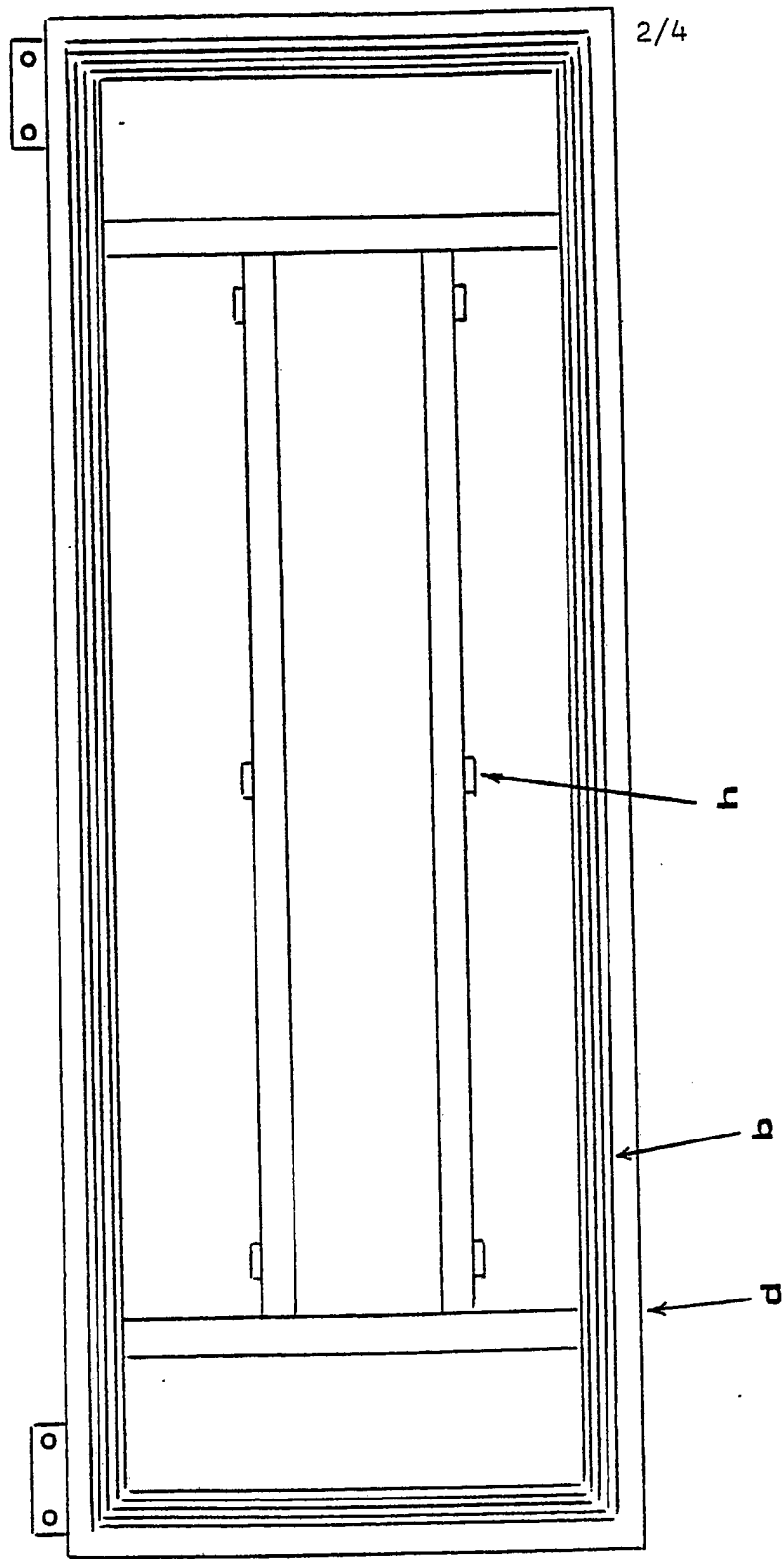


FIG 3

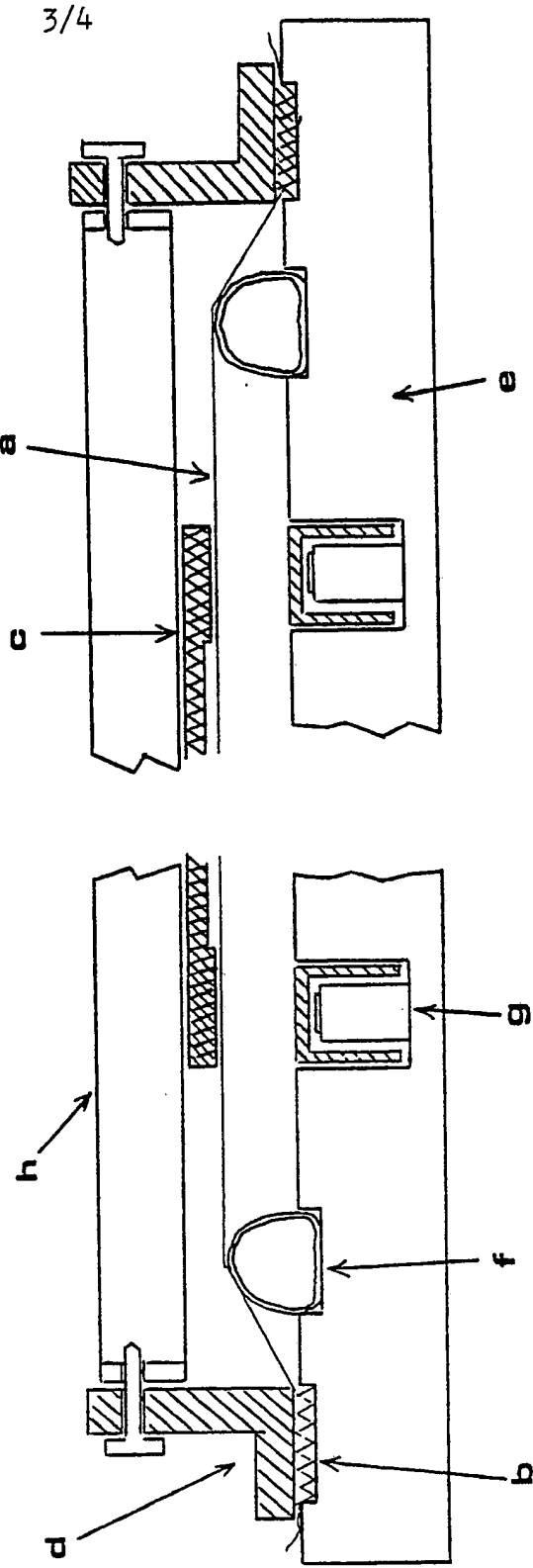
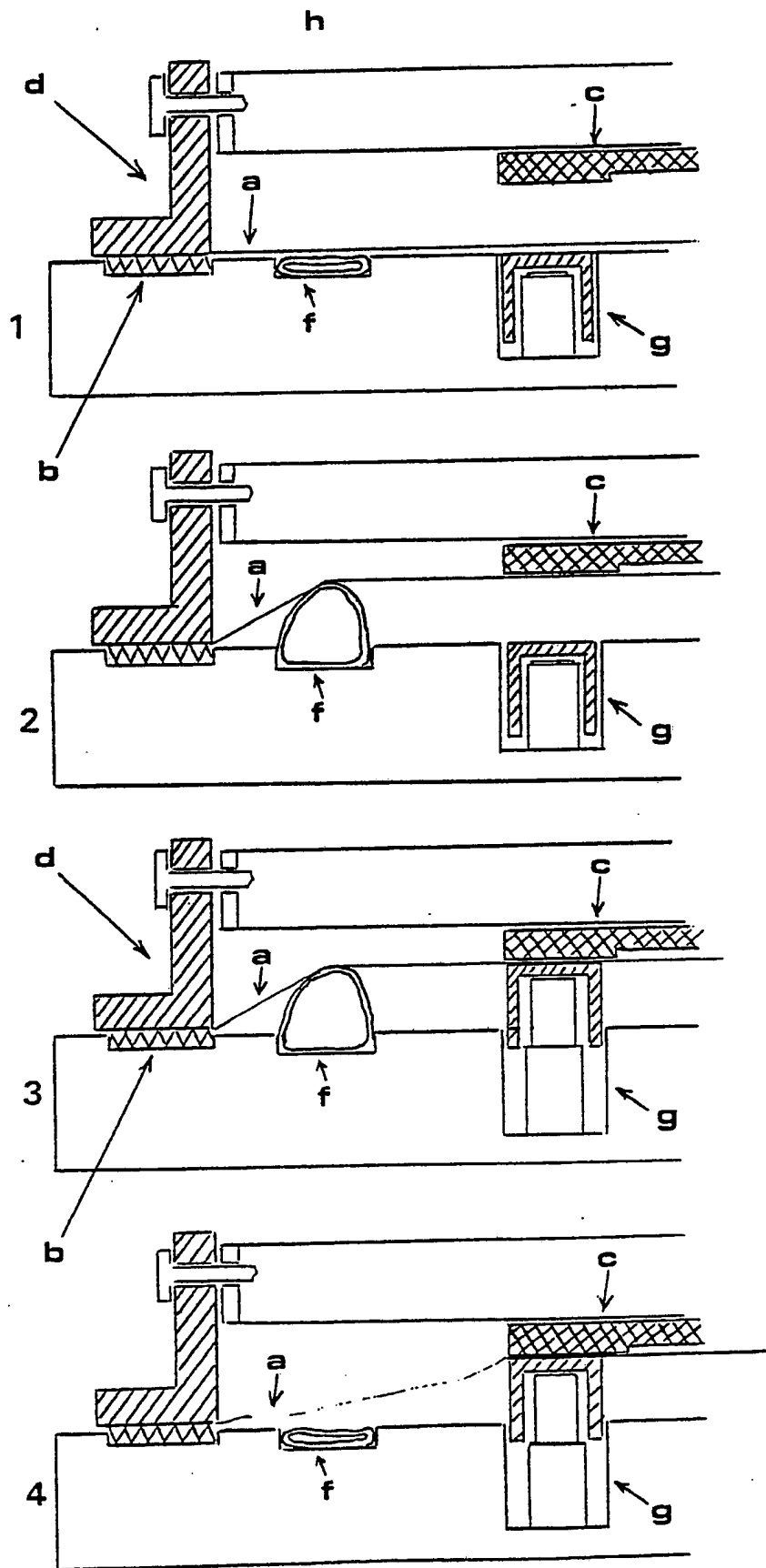


FIG 4

4/4



# INTERNATIONAL SEARCH REPORT

International Application No PCT/DK83/00093

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>3</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC <b>3</b>		
H 04 R 31/00		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>4</sup>		
Classification System	Classification Symbols	
IPC 3 US C1	H 04 R 31/00, 7/16-7/24 29: 594, 181: 171, 172	
Documentation Searched other than Minimum Documentation to the extent that such Documents are Included in the Fields Searched <sup>5</sup>		
SE, NO, DK, FI classes as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <sup>14</sup>		
Category <sup>6</sup>	Citation of Document, <sup>15</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>18</sup>
A	GB, A, 1 500 398 (SONY CORPORATION) 8 February 1978 & DE 2531585	
A	GB, A, 884 364 (ROLA CELESTION LIMITED) 13 December 1961	
A	SE, C, 29 825 (C E EGNER AND J G HOLMSTRÖM) 16 August 1909	
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<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search <sup>1</sup>	Date of Mailing of this International Search Report <sup>2</sup>	
1983-12-22	1984 -01- 0 <sup>3</sup>	
International Searching Authority <sup>1</sup>	Signature of Authorized Officer <sup>19</sup>	
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